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ABSTRACT

This document reports the results of a survey of 200 inservice high school biology teachers to determine preservice competencies necessary for high school biology teachers. Forty competencies were identified as necessary including: laboratory experience, techniques for instruction, laboratory management, preparation of laboratory materials, cutdoor skills, safety, use of microscopes, and knowledge of recent developments in curricula. (SL)

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A STUDY OF PRACTICIONERS' IDEAS ON PRE-SERVICE COMPETENCIES NEEDED FOR HIGH SCHOOL BIOLOGY TEACHERS

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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by

MARK ANTHONY STALLINGS

B. S., Georgia College, 1973

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

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Chapter 1

INTRODUCTION

Within the past ten years, the movement toward competency-based teacher education (CBTE) has accelerated at an increased rate. Part of the reason for this is the increase of need for relevance in the education of teachers. This relevance requires continual assessment of the relationship between teachers' education and their ultimate functioning as teachers. Dickson, Kean and Andersen stressed these two points on teacher education:

1. Our programs must continually reflect the real world. We must build into our programs the opportunity and space to promote regeneration to meet the changing conditions of the world.

2. We must understand and satisfy the needs of our students as both we and they perceive them. As teacher educators it is our function to help teachers perceive their needs and theirs to help us perceive and fulfill them.[1]

That teachers education does not meet the requirements of today's schools was further emphasized by Dodle and Scholock, who stated, "Teacher education has not kept pace with today's schools, and the gap between the present requirements and existing programs continues to increase."[2]

Dodl and Scholock further stated that in order for teacher education to keep pace with today's schools, there must be collaborative decisions on what behavior and what products are to serve as the criteria for competency assessment.[3] It is no longer possible or desirable for the teacher

education institution to be the major determinant of either program focus or certification requirements. However, there are no existing precedents for choosing the most appropriate mix of agencies and/or persons to select and specify appropriate knowledge, behaviors, or product outcomes. It seems reasonable that representatives from state departments of education, professional education associations, teacher unions, citizens from associated school districts and students should join university faculties in determining what knowledge, behaviors, and product outcomes shall stand as a basis for competency assessment.

With this in mind, a CBTE program was established at Kansas State University. Part of this program offers development of competencies for science teachers, and, in particular, for those responsible for laboratory learning in high school biology courses. The "laboratory techniques and skills" portion of the program is an attempt to minimize the perceived lack of congruence of teaching skills deemed necessary by practicing teachers and those skills evidenced by students completing teacher training at Kansas State University.

The purpose of this study was to attempt to identify the competencies appropriate for teachers responsible for biology laboratory learning in high schools in the State of Kansas, as perceived by practicing biology teachers in the state. Once these competencies are identified, they will be used as a base for the biology "laboratory techniques and skills" portion of the Kansas State University CBTE program.

To identify these competencies, a survey of practicing high school biology teachers was conducted in Kansas. These teachers were asked to rate 53 competencies as to their appropriateness for pre-service biology

teachers. Hopefully, the results from this survey will provide direction for the "laboratory techniques and skills" portion of science teacher training programs throughout the United States.

Statement of the Problem and Hypotheses

Due to the lack of identified competencies for pre-service high school biology teachers, this study concerns itself with the identification of the competencies necessary for a pre-service high school biology teacher to develop. In order to identify these competencies, a 53 item instrument was developed listing possible competencies and this instrument was administered to in-service high school biology teachers. Their reactions to this list would then identify priority competencies for pre-service high school biology teachers to develop.

The specific questions were: 1) What competencies do practicing biology teachers deem appropriate for pre-service biology teachers, 2) How do these practicing biology teachers rate their own skill level on these same competencies, and 3) What were the relationships between their ratings of appropriateness, self-assessed skill level and certain other characteristics. The following null hypotheses, related to Question 3 above, are stated:

H_1: There is no significant relationship in the responses to the level of appropriateness for pre-service biology teachers versus the level of skill responses for practicing biology teachers.

H_2: There is no significant relationship between the number of years of biology teaching experience of respondents and their responses for an item's level of appropriateness chosen on any item for a pre-service biology teacher.

H_3: There is no significant relationship between the number of years

of biology teaching experience of the respondents and the self-assessed skill level on any particular item by the respondents.

H_4: There is no significant relationship between the number of courses presently taught by the respondents and the level of appropriateness chosen for the pre-service biology teacher on any item.

H_5: There is no significant relationship between the number of courses presently taught by the respondents and a respondents' self-assessed skill level on any item.

H_6: There is no significant relationship between the type of degree held by the respondents and the level of appropriateness chosen for a pre-service biology teacher on any item.

H_7: There is no significant relationship between the type of degree held by the respondents and the respondents' self-assessed level on any item.

H_8: There is no significant relationship between the number of science hours taken by the respondents and the level of appropriateness chosen on any item for a pre-service biology teacher.

H_9: There is no signficant relationship between the number of science hours taken by the respondents and the respondents' self-assessed skill level on any item.

H_{10}: There is no significant relationship between the respondents teaching of advanced biology sections and the respondents' level of appropriateness chosen for a pre-service biology teacher on any item.

H_{11}: There is no significant relationship between the respondents' teaching of advanced biology sections and the respondents' self-assessed skill level on any item.

Definition of Terms

Competency Based Teacher Education. A program that specifies the objective for training in an explicit form, and holds the prospective teachers accountable for meeting those objectives.[4 and 5] For purposes of this study, the author considers that Performance Based Teacher Education is synonymous with CBTE.)

Laboratory Competencies. Areas of skills or knowledge from which specific competencies might be developed which are thought to be necessary for the successful conduct of a general biology laboratory.

Practicing Biology Teachers. Teachers that were engaged in teaching biology in Kansas Public Schools during the time this survey was taken.

Appropriateness to a Pre-Service Biology Teacher. The determination of desirability or need of a competency for a prospective high school biology teacher.

Skill Level of Practicing Biology Teachers. The determination of the amount of ability the respondents have to perform the competencies listed in the questionnaire.

This study is limited by the degree to which Kansas biology teachers may differ systematically from biology teachers elsewhere. The author discovered no reason to believe that systematic differences exist.

Chapter 2

REVIEW OF THE LITERATURE

Competency Based Teacher Education (CBTE) has been developed over the past 12 years in response to a number of forces, including relevance of teacher preparation as well as changing teacher attitudes. Teachers are reflecting this as they have become more political and less quiescent. Teachers of today will not ignore society's demands. As stated by Dickson, Kean and Andersen, "The task of those responsible for teacher education is to prepare teachers able to orchestrate those variables so that children can learn what best prepares them to improve mankind's relation to the world. Relevance requires that we continually assess the relationship between a teacher's education and their ultimate functioning as teachers."

CBTE is an attempt to make teacher education programs relevant and to respond to the changing nature of education in a changing society.[6] Since teachers' attitudes have changed, and they have shown that they will not be unresponsive to societal concerns, teacher education programs have responded by developing CBTE formats.[7] This format has a number of points, including:

(1) An individualized program that frees both students and teachers to work at their own rate.

(2) It makes the competencies to be acquired and demonstrated by the students explicit.

(3) It is flexible enough to set up a program that suits the needs of both the teacher and the student.[8]

Science Educators have taken advantage of this "revolution" in education by making use of the CBTE format. Schaff (1974) indicated the strength of a CBTE science program when he stated:

> Definite strides have been taken to remove the binds and vicious circles prevalent in science teacher education programs of the past. Innovations in science departments and teacher education programs reflect a concerned and concentrated effort by university faculties towards removing the chaos, ineffectiveness, and mindlessness from science teacher education. There is limited evidence to suggest that in universities where CBTE programs have been implemented and science departments have been slow and reluctant to change, a current study might result in pre-service science teachers viewing their education modules as much more valuable than science courses.[9]

Another indication of the gaining popularity and strength of CBTE science format was shown by the science teaching faculty at Governors State University in Illinois. In 1975, they were developing and implementing a competency-based, pre-service/in-service program for educating science teachers for elementary, middle and high schools. The program plans are being reviewed at this time by the Bureau of Teacher Certification of the Office of the Superintendent of Public Information, State of Illinois. The program would consist of learning modules and self-instructional packages to aid students in acquiring competencies. The outcomes of that program are unknown at this time.

According to Trowbridge (1974), there is another aspect of CBTE to consider and be elaborated on this by saying:

> More than a dozen states at the present time (1974) have some type of legislation requiring this type of approach (CBTE) to teacher training. Many problems are inherent in this, and it is important that teacher training institutions give their full attention to it. The skills a teacher needs, the way to gain those skills, and how these skills may be evaluated for certification are questions that will need to be answered.[10]

Another important aspect of CBTE is the statement of objectives in behavioral terms. Schaff (1974) reminded us of this when he stated:

> The most difficult and crucial component of any CBTE program is the specification of objectives, i.e., the stating of terminal competencies of students resulting from instruction. Inherent within this task is the identification and specification of competent teacher characteristics and behavior (competencies).[11]

In response to this call for competency identification, there has been a trend in the last few years to identify purposes and functions, and competencies necessary for laboratory teaching. Beisenherz (1970), found that while undergraduates are "taught" competencies there is no actual relationship between total competencies "taught" and competencies required by the teaching situation they enter. In this study, Beisenherz selected 113 selected skills and techniques from laboratory manuals, sourcebooks for high school biology and BSCS materials and constructed an instrument that he administered to three groups of people. These groups consisted of: prospective high school teachers of biology, professors of courses in biological sciences, and high school biology teachers. Beisenherz found that approximately fifty percent of the techniques listed on his instrument were reported to have been acquired during undergraduate preparation. More importantly, Beisenherz found that less than one-third of the techniques listed by him came from the required pattern of biological science courses. He ended his research calling for a special course in biological techniques.

In other research concerning science teacher preparation, Gennero and Boeck (1968) found that in spite of the greater depth of preparation in the subjects they teach, high school science teachers are not adequately

prepared to use all of the scientific apparatus which might be found in their laboratories. Part of the reason they cited for this is the ever increasing number of college science courses for which no laboratory instruction is provided as well as an increasing number of courses where the apparatus used in the laboratories is not of the type found in high schools.[12] In closing, Gennero and Boeck called for a self-instructional science laboratory that would enable teachers to gain the skills necessary for teaching. They have a model for this at the University of Minnesota that provides laboratory instruction for science teachers by using teaching units designed to be completed in 45 mintues at individual carels. The laboratory units cover biology, chemistry, physics, geology, meterology and astronomy.

Concerning the specific preparation of high school biology teachers, it was said by Mazer and Kormondy that in their current academic preparation:

> (1) Prospective biology teachers are taught biology one way but are expected to teach in quite another way.
>
> (2) Prospective biology teachers are given the facts of biology by biologists in thirty or more semester hours of biology courses, but are expected to learn how to teach biology in approximately nine semester hours of methodology and practice teaching.[13]

The problems that Mazar and Kormondy point out are not specific to the preparation of high school biology teachers. This was also pointed out by a study conducted by James and Schaff in 1973. In this study, they identified "priority" areas of competence necessary for physical science teachers in the State of Kansas. These priority areas of competence established a base from which a portion of the CBTE program at Kansas

State University now operates with regard to physical science teacher preparation.

Since the need for better biology teacher training has been identified, the author has set out to identify the crucial areas of laboratory teaching competence necessary for beginning biology teachers. The identification of these areas of competence will hopefully form a base for the biology portion of the "Laboratory Techniques and Skills" portion of the Kansas State University CBTE program and similar programs throughout the United States.

Chapter 3

METHODS AND PROCEDURES

Sample

The survey was administered during late February and early March of 1976 to a sample of two-hundred high school teachers currently teaching in the State of Kansas. They were randomly selected from a computer printout obtained from the Kansas State Department of Education which listed all high school biology teachers by subject in Kansas. The actual time of biology teaching experience for the respondents ranged from one year to 37 years, and the number of general biology sections currently taught ranged from zero to five. Many of the sample population taught more specialized biology courses, such as physiology and botany.

Instrumentation

This instrument was developed by making a list of biology laboratory competencies that were obtained from a review of the literature, sessions with biology teachers, and input from science educators. One-hundred-and-twenty-four items were developed in this manner. This list is separated into sections, "Techniques for Instruction", "Laboratory Management", "Laboratory Experience", "Maintaining Live Organisms in the Laboratory", "Preparation of Materials in the Laboratory", "Outdoor and Field Skills", "Equipment", "Safety", "Identification", "Microscopy", and "Recent Developments in Curricula" (see Appendix B). This instrument was then administered to 27

Science Education professors across the country. Each respondent was asked to mark each item as "appropriate" or "not appropriate". Fourteen responded to the instrument. Their responses and comments were tallied on a master sheet. The items which were numerically superior in "not appropriate" responses were deleted. Many items were combined with other items on the instrument, using the respondents' suggestions in the comments column of the instrument.

Along with this input, an additional step was taken. Upon the suggestion of the CBTE Science Education faculty members, contacts were made with five biology teachers in nearby schools. The same instrument that was administered to the Science Educators was administered to these teachers (with the Science Educators' deletions pointed out) to get their reactions as to wording and understanding. They also made some suggestions on combining several items and retained some of the items deleted by the Science Educators. The result of both the Science Educators' and the teachers' input was the final 53 items used in the instrument.

The format of the final instrument was determined in consultation with instrument design personnel of the College of Education, Kansas State University. The response selections, instrument outline, and other details were determined in consultation with Kansas State University instrument design personnel (see Appendix B).

Two responses were solicited for each area of competence. The first was a five point scale in response to statements concerning basic areas of competence needed by beginning biology teachers responsible for biology laboratories. The five point scale was defined as follows:

Appropriateness for beginning biology teachers.

I deem this skill to be:
5 - clearly appropriate
4 - somewhat appropriate
3 - uncertain or intermediate
2 - somewhat inappropriate
1 - clearly inappropriate

The second response was also on a five point scale concerning the skill level each teacher felt that he/she possessed in that area. It was defined as follows:

Personal feelings of competency.

I consider myself to be:
5 - clearly skilled
4 - somewhat skilled
3 - uncertain or intermediate
2 - somewhat unskilled
1 - clearly unskilled

Several general information questions were placed on the survey form. These questions included the respondents' years of teaching experience, number of biology sections taught, number of science hours taken by the respondents in college, highest degree held, and specialized biology courses taught.

Procedures

In preparation for administering the instrument, a random sampling of two-hundred names of high school biology teachers and their high school addresses was taken from a computer printout supplied by the Kansas State Department of Education. A copy was made of the printout and the names were cut apart, put into a box and mixed thoroughly. Two-hundred names were drawn and alphabetized. Because of the listing by subject, some duplications occurred, and new names were drawn to replace them. Then a mailing list on gummed labels was prepared and numbered consecutively from one to two-hundred. The survey instruments were coded to enable the author to keep track of those who responded.

The survey questionnaires were then mailed to the two-hundred chosen participants. A cover letter was included (see Appendix A) explaining the purpose of the survey and to express appreciation to participants for taking time to respond to the form.

The numbered returns after the initial mailing totaled 122. After ten days a postcard reminder was sent to those who had not yet responded (see Appendix A). After a period of seven more days, an additional cover letter (see Appendix A) and instrument was sent to those who had not responded. The total responses after sending the postcards and second cover letter and instrument came to 46. This gave a grand total of 168 responses to the questionnaire and represents an eighty-four percent return.

Data Analysis

The raw data (response form) was keypunched onto computer cards by Kansas State University's computer center for use in computer analysis. A cross-tabulation of the 53 items among themselves and the demographic data was made, and a Chi-Square Test of Independence was run on each cross-tabulation display.[14] The results of the Chi-Square Tests of Independence for each cross tabulation display were listed individually if they were found to be significant. A non-parametric (Spearman) correlation was also run to check the relationship between responses for appropriateness for pre-service biology teachers and responses concerning the skill level of the practicing biology teachers.

The demographic data and response data were tabulated and listed as totals by item. Means, medians, and modes were tabulated and listed to facilitate a simple item analysis.

Chapter 4

RESULTS OF THE STUDY

Tabulation of the demographic data showed the number of years of biology teaching experience of the survey respondents (Table I); the number of biology sections taught by the respondents (Table II); whether or not other courses than biology were taught (Table III); the degree held by the respondents (Table IV); the number of semester science hours taken by the respondents (Table V): and, finally, the number of respondents that taught advanced biology sections (Table VI).

TABLE I

YEARS OF BIOLOGY TEACHING EXPERIENCE OF RESPONDENTS

Years	Frequency	Percent
1	12	7.1
2	12	7.1
3	24	14.3
4	10	6.0
5	7	4.2
6	13	7.7
7	5	3.0
8	8	4.8
9+	79	44.6

Mean = 6.235
Median = 7.5
Standard Deviation = 2.972

TABLE II

NUMBER OF BIOLOGY SECTIONS TAUGHT BY RESPONDENTS

# of Sections	Frequency	Percent
1	28	16.7
2	39	23.2
3	14	8.3
4	31	18.5
5	39	23.2
6	6	3.6
7	2	1.2
8	1	0.6

Mean = 3.281
Median = 3.429
Standard Deviation = 1.657

TABLE III

RESPONSE TOTALS ON WHETHER OTHER COURSES WERE TAUGHT

Response	Frequency	Percent
Yes	125	74.4
No	43	25.6

TABLE IV

DEGREE HELD BY THE RESPONDENTS

Degree	Frequency	Percent
B.S. or B.A.	80	47.6
M.S. or M.A.	81	48.2
Ph.D. or Ed.S.	6	3.0

TABLE V

NUMBER OF SCIENCE HOURS TAKEN BY RESPONDENTS

Hours	Frequency	Percent
20	1	0.6
25	7	4.2
30	8	4.8
35	10	6.0
40	14	8.3
45	23	13.7
50	14	8.3
50+	91	54.2

TABLE VI

RESPONSE TO WHETHER ADVANCED BIOLOGY SECTIONS WERE TAUGHT

Response	Frequencey	Percent
Yes	91	54.2
No	77	45.8

The responses to each of the 53 items on the instrument were listed along with their names under their original headings (see Tables VII through XVII). This enabled the author to look at the position of each item and its relationship to the other items on the survey.

TABLE VII

LABORATORY EXPERIENCES

		APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1.	Dissection of laboratory specimens.	4.48	4.44
2.	How to type blood.	4.26	4.44
3.	Collection and isolation of microorganisms.	3.76	3.55
4.	Analysis of water for pollutants.	3.69	3.33
5.	Food and nutrition experiments.	3.60	3.57
6.	Bacteriological examination of soil and water.	3.52	3.19
7.	Observation of plant growth as governed by hormones.	3.52	3.33

TABLE VIII

TECHNIQUES FOR INSTRUCTION

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Selected demonstrations appropriate to modern biology	4.46	3.93
2. Guidance in directing individual student investigations.	4.36	3.99
3. Developing introductory laboratory exercises.	4.25	3.93
4. Preparation and use of display materials.	3.83	3.55
5. Skills necessary to conduct an individualized laboratory program.	3.80	3.53
6. Developing environmental sampling techniques.	3.58	3.21
7. Organization and use of nature trails.	3.51	3.26
8. Take-home experiments.	3.02	2.95

TABLE IX

MAINTAINING LIVE ORGANISMS IN THE LABORATORY

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Caring for live plant and animal specimens.	4.29	4.02
2. Care and use of terria and aquaria.	4.10	3.90
3. Culturing of Planaria, Fruit Flies, etc.	3.75	3.55

TABLE X

LABORATORY MANAGEMENT

		APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1.	Effective laboratory discipline.	4.52	4.33
2.	Evaluating student progress in a laboratory setting.	4.29	4.00
3.	Storage and organization of laboratory items.	4.18	4.04
4.	Effective use of teacher aides and laboratory assistants.	4.09	3.81
5.	Knowledge of planning for science facilities.	3.69	3.68

TABLE XI

PREPARATION OF MATERIALS IN THE LABORATORY

		APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1.	Preparation of plant and animal cultures.	3.95	3.62
2.	Construction of simple biological models.	3.80	3.46
3.	Proper use of preservatives and fixitives.	3.74	3.86
4.	Use of animal skeletons.	3.51	3.62

TABLE XII

OUTDOOR AND FIELD SKILLS

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Ability to organize and execute a field trip.	4.22	3.95
2. Collection of plant and animal specimens.	3.97	4.01
3. Effective use of an outdoor laboratory.	3.94	3.53
4. Studying various types of animal behavior.	3.68	3.54

TABLE XIII

EQUIPMENT

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. The procurement and use of low budget equipment.	4.20	3.81
2. General maintenance and repair of laboratory equipment and facilities.	4.11	3.73
3. Evaluating the quality of equipment and then purchasing according to need and future use.	4.00	3.92
4. Use of field equipment; plankton net, aquatic insect collecting equipment, bird nets and so on.	3.83	3.63
5. Construction of homemade equipment.	3.79	3.30

TABLE XIV

SAFETY

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Safety and teacher responsibility.	4.80	4.50
2. Proper handling of chemicals.	4.64	4.27
3. Instruction in laboratory safety.	4.51	4.33
4. Dealing with laboratory emergencies.	4.49	4.20
5. Proper use of specimen killing agents and preservatives.	4.27	3.98

TABLE XI

IDENTIFICATION

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Knowledge of local flora and fauna.	4.09	3.70
2. Use of keys in animal identification.	4.05	3.96
3. Use of keys in plant identification.	3.99	3.95

TABLE XVI

MICROSCOPY

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Adjustment of microscopes.	4.49	4.32
2. Use of prepared slides.	4.27	4.29
3. Use of binocular dissecting microscopes.	4.16	3.74
4. Temporary slides wholemounts.	3.97	3.71
5. Use of projecting microscopes.	3.78	3.73
6. Microtechniques; preparation, staining and future storage of slides.	3.52	3.51

TABLE XVII

RECENT DEVELOPMENTS IN CURRICULA

	APPROPRIATENESS MEAN	SKILL LEVEL MEAN
1. Exposure to any and all innovative programs so that a selective process can occur in the mind of the potential teacher.	4.08	3.69
2. Sources and role of periodical literature.	4.05	3.82
3. Awareness of BSCS, philosophy and content.	3.50	3.89

The data was then subjected to statistical analysis, using the Chi-Square Test of Independence on a cross-tabulation display, and by using the non-parametric Spearman correlation. The results, as related to each hypothesis, are listed in numerical order (Hypotheses 1 through 11).

Null Hypotheses

H_1: There is no significant relationship in the response to the level of appropriateness for pre-service biology teachers versus the level of skill responses for practicing biology teachers.

There was a significant relationship shown by the Chi-Square test at the .05 level, between the respondents' assessing an item's appropriateness for a pre-service biology teacher and the respondents' self-assessed skill level on most of the items. For convenience, the questions that did not have a significant relationship are listed below:

Number 6 - Analysis of water for pollutants.

" 9 - Skills necessary to construct an individualized laboratory program.

" 10 - Selected demonstrations appropriate to modern biology.

" 21 - Knowledge of planning for science facilities.

" 25 - Preparation of plant and animal cultures.

" 29 - Ability to organize and execute a field trip.

" 30 - Effective use of an outdoor laboratory.

" 33 - Evaluating the quality of equipment and then purchasing according to need and future use.

The Spearman correlation applied to the responses of appropriateness of an item for a pre-service biology teacher and the responses for self-determined skill level showed a relationship at the .01 level of significance for every item. Since this correlation was significant on all of the items in the survey instrument (see Appendix B), the author felt that listing these items would be unnecessary since the Appendix contains the entire survey instrument.

The results of these two tests show that there is a strong relationship at the .01 level on the Spearman, and at the .05 level (on all but eight items) using the Chi-Square Test on Independence. Therefore, the null hypothesis is rejected for all of the items.

This relationship reflects the fact that if a respondent feels that he has a higher level of skill in an area of competence, then he responds at a higher level to the appropriateness of that same area of competence for a pre-service biology teacher.

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H_2: There is no significant relationship between the number of years of biology teaching experience of respondents and their responses for an item's level of appropriateness chosen on any item for a pre-service biology teacher.

The Chi-Square Test of Independence run on the cross-tabulation display showed a significant relationship at the .05 level between the number of years of biology teaching experience and the responses for appropriateness. for pre-service biology teachers on the following items:

Number 11 - Developing introductory laboratory exercises.
" 17 - Care and use of Terria and Aquaria.
" 24 - Construction of simple biological models.
" 32 - The procurement and use of low budget equipment.
" 34 - General maintenance and repair of laboratory equipment and facilities.
" 35 - Construction of homemade equipment.
" 44 - Knowledge of local flora and fauna.

The null hypothesis is therefore rejected for the above items and retained for the remainder of the items on the instrument.

This relationship implies that the more years of biology teaching experience a respondent had, the more apt he was to feel that these items are more appropriate for a pre-service biology teacher.

--

H_3: There is no significant relationship between the number of years of biology teaching experience of the respondents and the self-assessed skill level on any particular item by the respondents.

The Chi-Square Test of Independence run on the cross-tabulation display showed a significant relationship at the .05 level between the number of years of biology teaching experience and the respondents' self-assessed skill level in the following items:

Number 12 - Organization and use of nature trails.
" 19 - Storage of laboratory items.
" 21 - Planning for science facilities.

" 22 - Evaluating laboratory progress.
" 34 - Maintenance of laboratory equipment.
" 37 - Instruction in laboratory safety.
" 38 - Safety and teaching responsibility.
" 40 - Dealing with laboratory emergencies.
" 43 - Use of keys in animal identification.
" 44 - Knowledge of local flora and fauna.
" 46 - Adjustment of microscopes.
" 47 - Use of binocular microscope.
" 48 - Use of prepared slides.

The null hypothesis is therefore rejected for the above items and retained for the rest of the items on the instrument.

This relationship implies that the more years of biology teaching experience a respondent had, the more apt he was to feel himself skilled at a higher level in these areas of competence.

--

H_4: There is no signficant relationship between the number of courses presently taught by the respondent and the level of appropriateness chosen for a pre-service biology teacher on any item.

Using the Chi-Square Test of Independence on the cross-tabulation display, no items were found to be at the .05 level of significance. Therefore, the hypothesis is retained for all items on the instrument.

--

H_5: There is no significant relationship between the number of courses presently taught by a respondent and a respondent's self-assessed skill level on any item.

Using the Chi-Square Test of Independence on the cross-tabulation display, no items were found to be at the .05 level of significance. Therefore, the hypothesis is retained for all items on the instrument.

--

H_6: There is no significant relationship between the type of degree held by a respondent and the level of appropriateness chosen for a pre-service biology teacher on any item.

Using the Chi-Square Test of Independence on the cross-tabulation display, no items were found at the .05 level of significance. Therefore, the hypothesis is retained for all items on the instrument.

--

H_7: There is no signficant relationship between the type of degree held by a respondent and the respondent's self-assessed level on any item.

Using the Chi-Square Test of Independence on the cross-tabulation display, no items were found at the .05 level of significance. Therefore, the hypothesis is retained for all items on the instrument.

--

H_8: There is no significant relationship between the number of science hours taken by a respondent and the level of appropriateness chosen on any item for a pre-service biology teacher.

There was a significant relationship at the .05 level using the Chi-Square Test of Independence on the cross-tabulation display between the number of science hours taken and the appropriateness for pre-service biology teachers on the following items:

Number 1 - Bacteriological examination of soil and water.
" 2 - How to type blood.
" 6 - Analysis of water for pollutants.
" 8 - Guidance in directing individual student investigations.
" 9 - Skills necessary to construct an individualized laboratory program.
" 11 - Developing introductory laboratory exercises.

Number 15 - Developing environmental sampling techniques.

" 17 - Care and use of Terria and Aquaria.

" 19 - Storage and organization of laboratory time.

" 20 - Effective use of teacher aides and laboratory assistants.

" 21 - Knowledge of planning for science facilities.

" 22 - Evaluating student progress in a laboratory setting.

" 23 - Effective laboratory discipline.

" 24 - Construction of simple biological models.

" 27 - Proper use of preservatives and fixatives.

" 30 - Effective use of an outdoor laboratory.

" 33 - Evaluating the quality of equipment and then purchasing according to need and future use.

" 36 - Use of field equipment; plankton net, aquatic insect collecting equipment, bird nets, and so on.

" 37 - Instruction on laboratory safety.

" 38 - Safety and teacher responsibility.

" 39 - Dealing with laboratory emergencies.

" 40 - Proper handling of chemicals.

" 41 - Proper use of specimen killing agents and preservatives.

" 42 - Use of keys in plant identification.

" 43 - Use of keys in animal identification.

" 44 - Knowledge of local flora and fauna.

" 47 - Use of binocular dissecting microscope.

" 48 - Use of prepared slides.

" 49 - Microtechniques, preparation, staining and future storage of slides.

" 52 - Exposure to any and all innovative programs so that a selective process can occur in the mind of the potential teacher.

" 53 - Sources and role of periodical literature.

The null hypothesis is therefore rejected for the above items and retained for the rest of the items on the instrument.

This relationship implies that the more hours a respondent has in science, the more apt he is to feel that these items are more appropriate for a pre-service biology teacher.

--

H_9: There is no significant relationship between the number of science hours taken by a respondent and the respondent's self-assessed skill level on any item.

There was a significant relationship between the number of science hours taken by the respondents and the respondent's self-assessed skill level in the following items:

Number 2 - How to type blood.
" 21 - Knowledge of planning for science facilities.
" 33 - Evaluating the quality of equipment and then purchasing according to need and future use.
" 35 - Construction of homemade equipment.
" 36 - Use of field equipment; plankton net, aquatic insect collecting equipment, bird nets, etc.
" 38 - Instruction in laboratory safety.
" 39 - Dealing with laboratory safety.
" 40 - Proper handling of chemicals.
" 41 - Proper use of specimen killing agents and preservatives.
" 42 - Use of keys in plant identification.
" 46 - Adjustment of microscope.
" 47 - Use of binocular dissecting microscope.

The null hypothesis is therefore rejected for the above items and retained for the remaining items on the instrument.

This relationship implies that the more college hours in science a respondent had, the more apt he is to feel skilled at a higher level in these areas of competence.

--

H_{10}: There is no significant relationship between the respondent's teaching of advanced biology sections and the respondent's level of appropriateness chosen for a pre-service biology teacher on any item.

Using the Chi-Square Test of Independence, no items were found at the .05 level of significance. Therefore, the null hypothesis is retained for all of the items in the instrument.

--

H_{11}: There is no significant relationship between the respondent's teaching of advanced biology sections and the respondent's self-assessed skill level on any item.

The respondent's teaching of advanced biology sections and the respondent's self-assessed skill level also showed a significant relationship on some items:

Number 3 - Observation of plant growth as governed by hormones.
" 30 - Effective use of an outdoor laboratory.
" 31 - Collection of plant and animal specimens.
" 36 - Use of field equipment; plankton net, aquatic insect collecting equipment, bird nets, etc.
" 41 - Proper use of specimen killing agents and preservatives.
" 44 - Knowledge of local flora and fauna.
" 47 - Use of binocular dissecting microscope.

The null hypothesis is therefore rejected for the above items and retained for the remaining items on the instrument.

This relationship implies that the teaching of advanced biology sections makes a respondent more apt to feel himself more skilled at a higher level in these areas of competence.

Medians, modes and column totals were prepared and listed in a column beside the questions on the instrument (see Appendix C).

There were some responses missing on individual items on a number of the questionnaires. These missing responses were not counted in any of the totals or tabulations.

Chapter 5

SUMMARY AND CONCLUSIONS

Priority Areas of Competence for Pre-service Biology Teachers

Those items rated by practitioners as most appropriatene can be thought of as the highest areas of competence. The author has judged that the items with a mean of 3.75 or greater should be considered to be in this category. These items have been extracted from Tables VIII through XVII and are listed below:

Laboratory Experiences

1. Dissection of laboratory specimens.
2. How to type blood.
3. Collection and isolation of micro-organisms.

Techniques for Instruction

1. Selected demonstrations appropriate to modern biology.
2. Guidance in directing individual student investigations.
3. Developing introductory laboratory exercises.
4. Preparation and use of display materials.
5. Skills necessary to construct an individualized laboratory program.

Maintaining Live Organisms in the Laboratory

1. Caring for live plant and animal specimens.
2. Care and use of terria and aquaria.
3. Culturing of planaria, fruit flies, etc.

Laboratory Management

1. Effective laboratory discipline.

Laboratory Management (cont.)

2. Evaluating student progress in a laboratory setting.
3. Storage and organization of laboratory items.
4. Effective use of teacher aides and laboratory assistants.

Preparation of Materials in the Laboratory

1. Preparation of plant and animal cultures.
2. Construction of simple biological models.

Outdoor and Field Skills

1. Ability to organize and execute a field trip.
2. Collection of plant and animal specimens.
3. Effective use of an outdoor laboratory.

Equipment

1. The procurement and use of low budget equipment.
2. General maintenance and repair of laboratory equipment and facilities.
3. Evaluating the quality of equipment and then purchasing according to need and future use.
4. Use of field equipment, plankton net, aquatic insect collecting equipment, bird nets, and so on.
5. Construction of homemade equipment.

Safety

1. Safety and teacher responsibility.
2. Proper handling of chemicals.
3. Instruction in laboratory safety.
4. Dealing with laboratory emergencies.
5. Proper use of specimen killing agents and preservatives.

Identification

1. Knowledge of local flora and fauna.
2. Use of keys in animal identification.
3. Use of keys in plant identification.

Microscopy

1. Adjustment of microscopes.
2. Use of prepared slides.
3. Temporary slide wholemounts.
4. Use of binocular microscopes.
5. Use of projecting microscopes.

Recent Developments in Curricula

1. Exposure to any and all innovative programs so that a selective process may occur in the mind of the potential teacher.
2. Sources and role of periodical literature.

Teacher educators should give highest priority to these areas of competence for pre-service biology teachers.

After listing the items found to be the high priority items, the author feels it is appropriate to list the items that were not found to be of high priority. These items include:

1. Bacteriological examination of soil and water.
2. Observations of plant growth as governed by hormones.
3. Food and nutrition experiments.
4. Analysis of water for pollutants.
5. Organization and use of nature trails.
6. Take home experiments.
7. Developing environmental sampling technique.
8. Knowledge of planning for science facilities.
9. Use of animal skeletons.

10. Proper use of preservatives and fixitives.
11. Studying various types of animal behavior.
12. Microtechniques; preparation, staining and future storage of slides.
13. Awareness of BSCS, philosophy and content.

The one thing that the author infers with the rejection of these 13 items is that each of the items seems to be time consuming. There may be another explanation and further data is necessary to draw any conclusions.

Demographic Data Findings

The demographic data revealed a number of items of interest that should be useful to science educators. Sixty percent of the biology teachers in the study had taught five or more years. This may be generalized to include all of Kansas, showing an older, more established biology teacher population. The biology teacher turnover rate appeared to be slow as indicated by the new teacher population amounting to about 7 percent of the total population in each of the first two years of the biology teaching experience table (see Table I).

The number of biology sections taught by the respondents varied (see Table II) with 39.9 percent of the teachers having one or two sections of biology per day. A total of 66.7 percent taught less than the "normal" load of five sections. This collaborates well with the fact that 74.4 percent of the teachers responded as having to teach other courses (see Table III). It would be well for a training program to keep this fact in mind.

Another interesting aspect of the study was that 51.2 percent of the respondents held a degree of masters or above (see Table IV). In considering the fact that the population is generally older and more established, it would seem that they have continued their education for both professional and financial reasons. The fact that 54.2 percent of the sample population had more than 50 semester hours of science courses (see Table V) reinforces the belief in a larger number of higher-degree biology teachers and that further training seems to be the rule. A teacher-training program should reflect this and not cause the trainees to believe that upon graduation one may teach for many years without additional training. This generally does not seem to be the case.

Advanced biology sections were taught by over half of the population (see Table III) and to the author this reflects the need for more advanced training as the advanced biology sections are generally more specialized and the students need more guidance and help from the teacher. Hence, the author sees the need for more specialization training on the part of the teachers' teaching advanced courses.

Discussion of Statistical Findings

The results of the demographic survey are predictably related to the respondents selection of certain items. As shown in Chapter Four, a relationship was shown in a number of instances, and the strongest was the relationship between the number of science hours taken and the self-assessed appropriateness of the item by the respondent for a pre-service biology teacher to possess (H_8). Many of these hours were probably obtained after graduation, as is reflected by the large number of respondents with higher degrees.

This may well reflect a need to obtain more education after graduation, but a number of biases may interfere and this should be more accurately studied before any conclusions are drawn.

Other interesting relationships were noted, such as the one revealed in the testing of the first hypothesis (H_1). These data show that teachers find areas of competence in which they rate themselves to be more highly skilled more appropriate for pre-service biology teachers. This is an obvious and positive trend as shown by the strength of the hypothesis rejection. However, it must be considered that part of this trend may be egocentric in that the teachers believe what they do well is good for others to learn.

In the second and third hypotheses (H_2 and H_3), a significant relationship was shown between the number of years of biology teaching experience and the assessed appropriateness for a beginning biology teacher and the respondent' self-assessed skill level in a number of cases. The trend in the second hypothesis seems to point toward equipment use, as shown by the respondents' choice of four items involving laboratory equipment out of the seven items listed. This may be generalized to say that the more years of biology teaching experience a respondent has, the more apt he is to think that proper equipment training was more appropriate for a pre-service biology teacher. The trend in the third hypothesis is in safety, microscopy, and laboratory management with each of these being significant. This may be generalized to say that the more years of biology teaching experience a respondent has, the more apt he is to rate himself more skilled in safety, microscopy and laboratory management.

Hypotheses four, five, six and seven had no significant relationship, so no trends were noted. This lack of statistical significance may be generalized to say that the number of biology sections taught and the type of degree held by the respondents was not influential in assessing of appropriateness and skill level of an area of competence. However, the simple answer listing on the instrument (see Appendix B) was a detriment in a true testing of the relationship of the degree held and appropriateness to a pre-service biology teacher and the self-assessed skill level of a respondent. The reader should accept these results cautiously.

The eighth hypothesis (H_8) was discussed earlier and hypothesis nine (H_9) had several significant items, with the trend forming in equipment and safety. This may be generalized to say that the more hours a respondent had, the more apt he was to feel himself more skilled in the areas of equipment and laboratory safety.

The fact that respondents taught advanced biology sections (H_{10}) had no significant effect on their choosing an item's appropriateness for a pre-service biology teacher. There was no trend established as no items were found to be significant here. However, in the eleventh hypothesis (H_{11}), there was a trend established with outdoor and field skills and microscopy having two of their items show up here. This may be generalized to say that if a respondent taught an advanced biology section, he would be apt to rate himself higher in skill level in outdoor and field skills and microscopy. This is a weaker trend and should be accepted cautiously.

Future Research Needs

There needs to be additional research done in the area of equipment and facilities that are currently available for biology teachers in Kansas

state schools. The lack of or abundance of biology equipment and facilities could have an effect on biology teacher training in order to prepare the prospective teacher for the situation he would be entering.

Also, the competencies identified in this research need to be further specified in more behavioral terms, i.e., the competencies need to be written out in a manner that would allow a teacher training instructor to give specific instructions on how to gain any of the competencies.

A third area for research would be to take the competencies identified and validify their use by practitioners. That is, to test their use and need in the public schools by biology teachers.

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APPENDICES

APPENDIX A

March 31, 1976

Dear Biology Teacher:

We are currently conducting some research to gain input from practicing biology teachers regarding the competencies which they feel should be mastered by pre-service biology teachers. A number of teacher education programs around the country are attempting to establish what is known as competency-based teacher preparation. We are concerned about who should establish these competencies and feel that the opinions of in-service biology teachers should be included in this decision-making process. This study is limited to the skills needed to conduct a high school biology laboratory.

A second area of concern relates to the competence of in-service biology teachers with respect to each skill. We are asking that you rate your own knowledge in each of the areas of competence listed.

As responsible researchers, we assure you of the confidentiality of individual responses. Each instrument has been numbered in the upper right-hand corner to make it possible for us to follow-up in case this copy is misplaced or forgotten. About twenty minutes of your time would be required to complete this instrument. Enclosed please find a stamped, self-addressed envelope. We are asking that you assist us by returning this instrument to us not later than April 12.

We appreciate your willingness to help us do a better job of serving the science teaching profession.

Sincerely,

Dr. Robert James
Professor, Science Education

Mr. Mark Stallings
Instructor, Science Education

RJ:MS:mcs

Dear Biology Teacher:

Recently you received a response form concerning competencies required for beginning biology teachers as well as your own personal feelings of competency for those same items.

It is important that we have as many responses as possible in order to make our survey valid, so your response is very important to us. Please return the enclosed form to us by April 29 so that we may complete our study.

Thank you for your help and cooperation. If we may be of help to you, please don't hesitate to call on us.

Sincerely,

Robert K. James
Professor, Science Education

Mark Stallings
Instructor, Science Education

RKJ:MS:ym

Enclosures

Dear Biology Teacher,

Recently you received a response form concerning competencies involving beginning biology teachers as well as teachers like yourself who are practitioners. We would appreciate it if you would complete and return the response form to us as soon as possible so that we may complete our study.

Thank you for your time and trouble.

Sincerely,

Dr. Robert James
Professor
Science Education

Mr. Mark A. Stallings
Instructor
Science Education

APPENDIX B

LIST OF SUGGESTED LABORATORY COMPETENCIES FOR HIGH SCHOOL BIOLOGY TEACHERS

Below are listed competencies which might be deemed appropriate for all high school biology teachers. Please respond to each of the competencies by marking "appropriate" or "not appropriate" in the column provided. Please feel free to add to, delete from or otherwise reword any of the competency areas in the comment section. We would appreciate any additional competencies that you think should be included in the instrument. These may be listed in the space provided at the end of each section.

Appropriate	Not Appropriate	Laboratory Experiences	Comments
___	___	1. The effect of various crude drugs on the cultivation of fungi and bacteria.	
___	___	2. Bacteriological examination of soil.	
___	___	3. Bacteriological examination of water.	
___	___	4. Studying the normal microbiological flora of humans.	
___	___	5. How to draw blood for typing.	
___	___	6. Blood typing.	
___	___	7. Analysis of water pollutants.	
___	___	8. Bio-plastic embedding.	
___	___	9. Observations on hormones and plant growth.	
___	___	10. Making laboratory drawings.	
___	___	11. Food and nutrition experiments.	
___	___	12. Dissection of laboratory specimens.	
___	___	13. Culturing of slime molds.	
___	___	14. Application of statistical analysis to biological data.	
___	___	15. Proper storage of insect specimens.	
___	___	16. Proper storage of animal specimens.	
___	___	17. Evolutionary characteristics of animals as seen through fossils.	
___	___	18. Urinalysis for diabetes.	
___	___	19. Collection and isolation of micro-organisms.	
___	___	20. Take home experiments.	

Appropriate	Not Appropriate		Techniques for Instruction	Comments
___	___	1.	Guidance in directing individual student investigations.	
___	___	2.	Awareness of alternative approaches of laboratory instruction.	
___	___	3.	Skills necessary to construct an individualized laboratory program.	
___	___	4.	Selected demonstrations appropriate to modern biology.	
___	___	5.	Developing laboratory exercises.	
___	___	6.	Introductory laboratory execises.	
___	___	7.	Nature trails; organization and use.	
___	___	8.	Commercial and homemade charts.	
___	___	9.	Proper use of biological models.	
___	___	10.	Use of demonstration and display materials.	
___	___	11.	Use of biological games.	

Laboratory Management

___	___	1.	Storage and organization of laboratory items.	
___	___	2.	Herbariums; use and design.	
___	___	3.	Effective use of laboratory assistants and teacher aides.	
___	___	4.	Knowledge of planning for science facilities.	
___	___	5.	Effective laboratory discipline.	
___	___	6.	Setting up or using a science or nature center.	
___	___	7.	Organization and supervision of a science fair.	
___	___	8.	Organization and use of a community museum.	
___	___	9.	Evaluating student progress in a laboratory setting.	

Appropriate	Not Appropriate	Maintaining Live Organisms in the Laboratory	Comments
___	___	1. Proper methods of handling live invertebrates.	
___	___	2. Proper methods of handling live vertebrates.	
___	___	3. Care and use of plants in the laboratory.	
___	___	4. Rearing insectivorous plants.	
___	___	5. Culture of planaria and other worms.	
___	___	6. Rearing of Daphnia and related anthropods.	
___	___	7. Care and observation of experimental mammals.	
___	___	8. Use of ants in observation nests.	
___	___	9. Use of bees in observation nests.	
___	___	10. Hydroponics; growing plants in a nutrient solution without soil.	
___	___	11. Provisions for housing live specimens.	
___	___	12. Maintaining a laboratory culture of common insects.	

		General	
___	___	1. Developing supportive public relations for science teaching.	
___	___	2. Various aspects of environmental education.	
___	___	3. Legal aspects of environmental protection.	
___	___	4. Organization and possible activities of a biology club.	
___	___	5. Knowledge of bio-feedback.	

Appropriate	Not Appropriate	Preparation of Materials in the Laboratory	Comments
___	___	1. Preparation of chick embryos for embryonic study.	
___	___	2. Culturing, sexing, and identification of fruit flies.	
___	___	3. Construction of biological models.	
___	___	4. Use of injection materials on freshly killed or recently preserved animals.	
___	___	5. Preparation of animal cell and organ cultures.	
___	___	6. Preparation of cultures and specimens.	
___	___	7. Preparation and use of animal skeletons.	
___	___	8. Preparation and use of animal specimens for dissection.	
___	___	9. Use of preservatives and fixitives.	
___	___	10. Plant pressing.	

		Outdoor and Field Skills	
___	___	1. Use of an outdoor laboratory	
___	___	2. Experience of planning and executing field trips.	
___	___	3. Setting up sites for field study.	
___	___	4. Collecting of insects.	
___	___	5. Organization and preparation for field study.	
___	___	6. Studying various types of animal behavior.	
___	___	7. Knowledge of bio-geography.	
___	___	8. Collecting aquatic insects.	
___	___	9. Collecting fish.	
___	___	10. Collecting birds.	

Appropriate	Not Appropriate	Equipment	Comments
___	___	1. Low budget equipment; the procurement and use of low cost items.	
___	___	2. Low budget equipment; securing the use of equipment when little is locally available.	
___	___	3. Evaluating the quality of equipment and then purchasing according to need and future use.	
___	___	4. General maintenance and repair of laboratory facilities.	
___	___	5. Construction of homemade equipment.	
___	___	6. Greenhouses; maintenance, management, class structure, building, costs.	
___	___	7. Establishing a Planetarium.	
___	___	8. Use of field equipment; plankton net, aquatic insect collecting equipment (such as baskets or nets), bird nets and so on.	
___	___	9. Care and use of aquaria.	
___	___	10. Care and use of Terraria.	
___	___	11. Use of water quality testing equipment.	
___	___	12. Construction and use of a weather station.	
___	___	13. Construction and use of an air pollution testing station.	
___	___	14. Slide-filmstrip projectors.	
___	___	15. Dissecting equipment.	
___	___	16. Videotape.	
___	___	17. Transparencies.	
___	___	18. Mounting plates.	
___	___	19. Use of film loops in the laboratory setting.	
___	___	20. Closed circuit TV.	

Appropriate	Not Appropriate	Safety	Comments
___	___	1. Instruction in laboratory safety.	
___	___	2. Safety and teacher responsibility.	
___	___	3. Dealing with laboratory emergencies.	
___	___	4. Proper handling of chemicals.	
___	___	5. Proper use of specimen killing agents.	

		Identification
___	___	1. Isolation and identification of organisms from an unknown mixture.
___	___	2. Use of keys in plant identification.
___	___	3. Use of keys in animal identification.
___	___	4. Identification of flowering plants.
___	___	5. Identification of fossil specimens.
___	___	6. Setting up an animal kingdom survey collection.
___	___	7. Use of a key in fish identification.
___	___	8. Use of a key in bird identification.
___	___	9. Use of a key in insect identification.

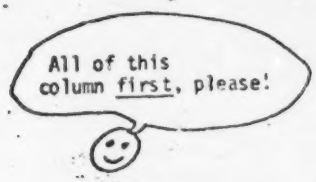
		Microscopy
___	___	1. Use of oil-immersion microscopes.
___	___	2. Use of phase-contrast microscopes.
___	___	3. Use of projecting microscopes.
___	___	4. Adjustment of microscopes.
___	___	5. Use of binocular dissecting microscopes.

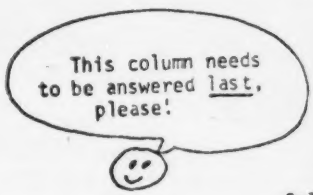
Appropriate	Not Appropriate	Microscopy (cont.)	Comments
____	____	6. Use of prepared slides.	
____	____	7. Microtechniques; preparation, staining and future storage of slides.	
____	____	8. Temporary slide wholemounts.	

Recent Developments in Curricula

____	____	1. BSCS, philosophy and content.	
____	____	2. ISIS.	
____	____	3. ISCS, Level III.	
____	____	4. Look at BSCS newsletter.	
____	____	5. Look at American Biology Teacher.	

Below are listed competencies which might be deemed appropriate for all high school biology teachers. Please respond to all items regarding appropriteness to beginning teachers first. These are on the left hand side of the page. After responding to those, please respond to the items concerning personal feelings of competence. The scales to use while responding are listed above each column. It is very important that you respond to all of the items in the left hand column before responding to the items in the right hand column.





Column 1

Column 2

Appropriateness for beginning biology teachers. I judge this skill to be:

1 Clearly inappropriate; 2 Somewhat inappropriate; 3 Uncertain or intermediate; 4 Somewhat appropriate; 5 Clearly appropriate

Personal feelings of competence: I consider myself to be-

1 Clearly unskilled; 2 Somewhat unskilled; 3 Uncertain or intermediate; 4 Somewhat skilled; 5 Clearly skilled

clearly inappropriate	somewhat inappropriate	intermediate	somewhat appropriate	clearly appropriate	Please circle the desired response.	clearly unskilled	somewhat unskilled	intermediate	somewhat skilled	clearly skilled
1	2	3	4	5	1. Bacteriological examination of soil and water.	1	2	3	4	5
1	2	3	4	5	2. How to type blood.	1	2	3	4	5
1	2	3	4	5	3. Observations of plant growth as governed by hormones.	1	2	3	4	5
1	2	3	4	5	4. Food and nutrition experiments.	1	2	3	4	5
1	2	3	4	5	5. Dissection of laboratory specimens.	1	2	3	4	5
1	2	3	4	5	6. Analysis of water for pollutants.	1	2	3	4	5
1	2	3	4	5	7. Collection and isolation of micro-organisms.	1	2	3	4	5
1	2	3	4	5	8. Guidance in directing individual student investigations.	1	2	3	4	5

1 2 3 4 5	9. Skills necessary to construct an individualized laboratory program.	1 2 3 4 5
1 2 3 4 5	10. Selected demonstrarions appropriate to modern biology.	1 2 3 4 5
1 2 3 4 5	11. Developing introductory laboratory exercises.	1 2 3 4 5
1 2 3 4 5	12. Organization and use of nature trails.	1 2 3 4 5
1 2 3 4 5	13. Preparation and use of display materials.	1 2 3 4 5
1 2 3 4 5	14. Take home experiments.	1 2 3 4 5
1 2 3 4 5	15. Developing environmental sampling technique.	1 2 3 4 5
1 2 3 4 5	16. Caring for live plant and animal specimens.	1 2 3 4 5
1 2 3 4 5	17. Care and use of Terria and Aquaria.	1 2 3 4 5
1 2 3 4 5	18. Culturing of Planaria, fruit flies, etc.	1 2 3 4 5
1 2 3 4 5	19. Storage and organization of laboratory items.	1 2 3 4 5
1 2 3 4 5	20. Effective use of teacher aides and laboratory assistants.	1 2 3 4 5
1 2 3 4 5	21. Knowledge of planning for science facilities.	1 2 3 4 5
1 2 3 4 5	22. Evaluating student progress in a laboratory setting.	1 2 3 4 5
1 2 3 4 5	23. Effective laboratory discpline.	1 2 3 4 5
1 2 3 4 5	24. Construction of simple biological models.	1 2 3 4 5
1 2 3 4 5	25. Preparation of plant and animal cultures.	1 2 3 4 5
1 2 3 4 5	26. Use of animal skeletons.	1 2 3 4 5
1 2 3 4 5	27. Proper use of preservatives and fixitives.	1 2 3 4 5
1 2 3 4 5	28. Studying various types of animal behavior.	1 2 3 4 5
1 2 3 4 5	29. Ability to organize and execute a field trip.	1 2 3 4 5
1 2 3 4 5	30. Effective use of an outdoor laboratory.	1 2 3 4 5
1 2 3 4 5	31. Collection of plant and animal specimens.	1 2 3 4 5
1 2 3 4 5	32. The procurement and use of low budget equipment.	1 2 3 4 5
1 2 3 4 5	33. Evaluating the quality of equipment and then purchasing according to need and future use.	1 2 3 4 5
1 2 3 4 5	34. General maintenance and repair of laboratory equipment and facilities.	1 2 3 4 5

1	2	3	4	5	35. Construction of homemade equipment.	1	2	3	4	5
1	2	3	4	5	36. Use of field equipment; plankton net, aquatic insect collecting equipment, bird nets and so on.	1	2	3	4	5
1	2	3	4	5	37. Instruction in laboratory safety.	1	2	3	4	5
1	2	3	4	5	38. Safety and teacher responsibility.	1	2	3	4	5
1	2	3	4	5	39. Dealing with laboratory emergencies.	1	2	3	4	5
1	2	3	4	5	40. Proper handling of chemicals.	1	2	3	4	5
1	2	3	4	5	41. Proper use of specimen killing agents and preservatives.	1	2	3	4	5
1	2	3	4	5	42. Use of keys in plant identification.	1	2	3	4	5
1	2	3	4	5	43. Use of keys in animal identification.	1	2	3	4	5
1	2	3	4	5	44. Knowledge of local flora and fauna.	1	2	3	4	5
1	2	3	4	5	45. Use of projecting microscopes.	1	2	3	4	5
1	2	3	4	5	46. Adjustment of microscopes.	1	2	3	4	5
1	2	3	4	5	47. Use of binocular dissecting microscopes.	1	2	3	4	5
1	2	3	4	5	48. Use of prepared slides.	1	2	3	4	5
1	2	3	4	5	49. Microtechniques; preparation, staining and future storage of slides.	1	2	3	4	5
1	2	3	4	5	50. Temporary slide wholemounts.	1	2	3	4	5
1	2	3	4	5	51. Awareness of BSCS, philosophy and content.	1	2	3	4	5
1	2	3	4	5	52. Exposure to any and all innovative programs so that a selective process can occur in the mind of the potential teacher.	1	2	3	4	5
1	2	3	4	5	53. Sources and role of periodical literature.	1	2	3	4	5

Personal information: This information will be kept completely confidential and will be used for group analysis ONLY.

1. Years of biology teaching experience_____.
2. Number of biology sections presently taught_____.
3. Do you teach other courses?_____.
   If so, what are they?_____
4. Highest degree held_____.
   In what field?_____.
5. Number of science hours taken. (Please circle one.)
   5 10 15 20 25 30 35 40 45 50 more
6. Do you teach any advanced biology sections?_____
   If so, what do they include?_____
   _____.

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FOOTNOTES

[1]Cooper, DeVault, et.al., Competency-Based Teacher Education, McCrutchen Publishing Corporation, 1973, Part I, p. 2.

[2]Ibid., p. 47.

[3]Ibid., p. 49.

[4]Ibid., Part II, p. 9.

[5]Rosner, Benjamin, Power of Competency-Based Teacher Education: A Report, Allyn and Bacon, Inc., 1972, p. 14.

[6]Op. Cit., Cooper, DeVault, et.al., p. 2.

[7]Ibid., p. 3.

[8]Ibid., p. 48.

[9]Schaff, John F., "Iniquitous Revolutions and Multiple Constraints in Science Teacher Education: Prospects for the Future", Science Education, April-June, 1974, p. 220.

[10]Trowbridge, Leslie W., "Secondary Science Teacher Education, Where Are We Going?", Science Education, April-June, 1974, p. 243.

[11]Op. Cit., Schaff, p. 219.

[12]Gennaro, E. D. and C. H. Boeck, "A Self-Instructional Laboratory for Science Teachers", Science Education, 1968, p. 274.

[13]Kormondy, Edward J. and William V. Mayer, The Pre-Service Preparation of Secondary School Biology Teachers, Commission on Undergraduate Education in the Biological Sciences, Publication 25, preface.

[14]Statistical package for the Social Sciences (SSPS). Developed at the University of Chicago by the National Opinion Research Center. The routine was "Cross-Tabs".